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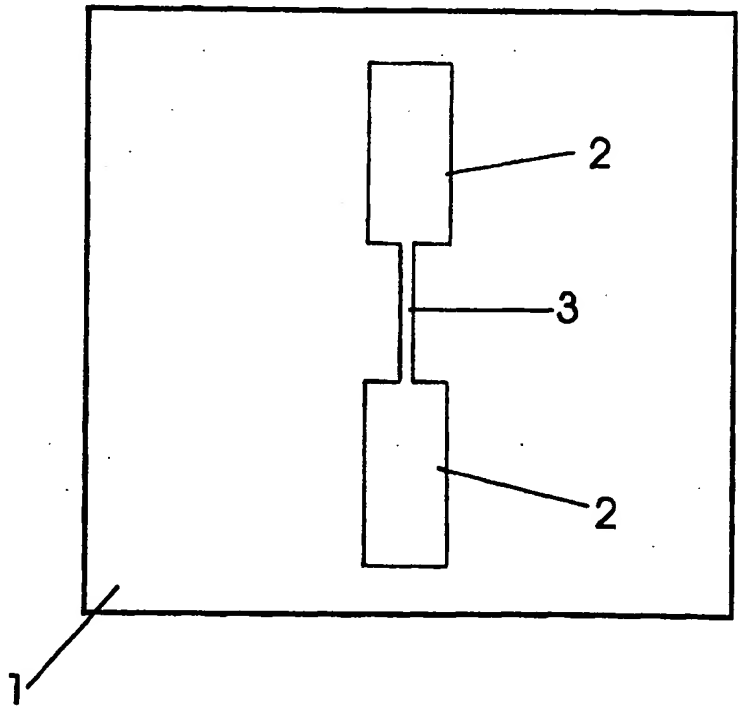
(54) Title: METHOD FOR MANUFACTURING A RESISTOR

(57) Abstract

A method for manufacturing a resistor function in an electric conductor on the surface of a carrier, preferably a conductor on printed circuit boards, substrates and chips. By etching using an anisotropic etching technique, the conductor is provided with at least one portion which has a smaller cross-sectional area than the conductor surrounding the portion, the length and width of the portion being such that a predetermined resistance is obtained in the conductor. A resistor according to the invention is on both sides connected to a conductor on a carrier, such as a printed circuit board, a substrate or a chip. The resistor comprises a conductor portion positioned on the carrier and having a significantly smaller cross-sectional area than the conductor on both sides of the resistor.



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METHOD FOR MANUFACTURING A RESISTOR

Field of the Invention

The present invention relates to a resistor and a method for manufacturing a resistor on carriers, preferably printed circuit boards, substrates and chips with or without integrated circuits, in the field of electronics.

Background Art

Printed circuit boards, substrates or chips have conductor structures on their surfaces or inside to connect other components, integrated functions or to connect to the surroundings. If resistor components are required, they are mounted as discrete components or applied as resistor pastes to printed circuit boards, substrates or chips so as to achieve the necessary resistance.

This is a time-consuming and complicated process. Therefore there is a need for a process which facilitates the manufacture of resistors.

Summary of the Invention

An object of the present invention is to overcome the above drawbacks and render the realisation of the resistor function in electronic products such as printed circuit boards, substrates and chips more effective.

These objects are achieved by a resistor and a method according to the appended claims.

A method for manufacturing a resistor function in an electric conductor on the surface of a carrier, preferably conductors on printed circuit boards, substrates and chips, according to the invention is characterised in that the conductor, by etching using an anisotropic etching technique, is provided with at least one portion which has a smaller cross-sectional area than the conductor on both sides of the portion, the length and width of the portion being such that a predetermined resistance is obtained in the conductor.

A resistor which on both sides is connected to a conductor on a carrier, such as a printed circuit board, a substrate or a chip, according to the invention is characterised in that the resistor comprises a conductor portion which is positioned on the carrier and which has a significantly smaller cross-sectional area than the conductor on both sides of the resistor.

By a significantly smaller cross-sectional area is meant that the cross-sectional area is smaller than 20%, preferably smaller than 5% of the cross-sectional area of the conductor.

A method according to the invention is based on the use of an anisotropic etching technique to generate conductor structures having a desired resistance.

By the resistor function being achieved by the conductor being provided with a portion of a smaller cross-sectional area, the resistor function can be made at the same time as the conductor structure on, for instance, a printed circuit board is made.

By the forming of the resistor function according to a preferred embodiment occurring in the normal conductor path, the resistor function can also be integrated in the internal conductor layers in multilayer printed circuit board or substrates, which causes improved distribution of the thermal energy generated by the resistor function.

According to a preferred embodiment of the present invention, the reduced cross-sectional area is a reduction of the width of the conductor in the plane of the surface. The desired resistance is then obtained by an adaptation of the width of the conductor or by adaptation of the length of the narrowed portion.

The conductors are preferably formed with a narrowed portion which has been etched by an anisotropic etching technique, to such a conductor width that such a noticeable resistance level is obtained that other resistor functions are not necessary in the extent of the conduc-

tor path between the other component connections to which an applied resistor function would have been connected.

According to an alternative embodiment of the present invention, the reduced cross-sectional area is provided by at least one essentially longitudinal groove being etched in the surface of the conductor. If the grooves are etched through the entire conductor, at least two essentially parallel conductors are obtained.

A person skilled in the art realises that the anisotropic etching technique is selected among known anisotropic etching techniques. The specific application determines which etching technique is to be chosen. Examples of anisotropic etching techniques are reactive ion etching, plasma etching and different kinds of wet etching.

According to a preferred embodiment of the present invention, use is made of a wet etching technique. This is advantageous from the viewpoint of costs.

According to a special aspect of the invention, use is made of a chemically etching etching fluid, in which the etchant, which constitutes the active substance, is present in a diluted solution. Extremely good results can be produced, such as exact etchings in small dimensions. This aspect of the invention is based on the surprising discovery that an etching fluid which has been diluted to have a negligible etching effect can be used for anisotropic etching under the action of an electric field.

This results in etching of an electrically conductive etching material by means of an etchant, which is present in a solution which is diluted to such a great extent as not to be practically usable for chemical etching. The etchant concentration is so low that such reactions between the etchant and the etching material as result in the removal of atoms from the etching material occur only sporadically. By an electric field being produced in the etchant solution between the electrode and a surface portion of the etching material, a local con-

centration of etchant forms on the surface portion of the etching material. This results in a pronounced increase of the etching rate of the etchant while at the same time the etching direction of the etchant is affected.

The described etching method is known from PCT Application SE97/01480.

If exact resistors are to be manufactured, it is advantageous to measure the resistance of the conductor during etching. When the measured resistance conforms with the desired value, the etching is interrupted.

The above features can, of course, be combined in the same embodiment.

In order to further elucidate the invention, detailed embodiments thereof will be described below, without the invention, however, being considered to be restricted thereto.

Brief Description of the Drawings

Fig. 1 illustrates a conductor on a printed circuit board, said conductor having a narrowed portion along part of the length of the conductor path, according to an embodiment of the invention.

Fig. 2 illustrates a conductor on a printed circuit board, said conductor having a plurality of parallel conductor portions along part of the length of the conductor path, according to an alternative embodiment of the invention.

Fig. 3 illustrates a conductor on a chip, said conductor having a portion with a conductor which is narrower than the surrounding conductor portions and which is longer than the distance between the surrounding conductor portions.

Detailed Description of the Invention

Fig. 1 shows a printed circuit board, substrate or chip 1 which has a conductor 2 with a narrowed portion 3 to provide the intended resistance in the conductor. As a result, no separate resistor component or resistor

pressure is required. The length and width of the narrowed portion have been adapted to produce the desired resistor. In the Figure, the narrowed portion has the same width over its entire length, but a person skilled in the art realises that the width may vary over the length.

Fig. 2a shows a printed circuit board, substrate or chip 1 which is provided with a conductor 4. Fig. 2b is a sectional view along line A-A in Fig. 2a. This is formed with etched grooves 6, which results in the conductor 2 having narrowed conductor portions 5. This, in turn, results in the desired resistance value while at the same time the distribution of current in a plurality of conductors distributes the generation of power on a larger surface. In the Figure, the grooves are etched through the thickness of the entire conductor, but alternatively the grooves extend only partly through the thickness of the conductor.

Fig. 3 illustrates a printed circuit board, substrate or chip 1 which is provided with one or more conductors 2. The conductor or conductors have been formed with a narrowed conductor portion 3 which has such a great narrowing 3 in a conductor pattern prolonged in relation to the distance between the conductor paths which are not narrowing, in order to increase the resistance value.

By thus increasing the length of the conductor, the width can be greater for a certain predetermined resistance compared with the case where the conductor is made straight. The narrowed conductor portion has been distributed over a larger surface, which means that the generation of power is distributed on a larger surface, which in turn leads to a lower temperature of the conductor.

The conductor structure in Fig. 3 has been produced by masking and etching.

The embodiments described above are only to be regarded as examples. A person skilled in the art realises that the above embodiments can be varied in a number of ways without deviating from the inventive idea.

CLAIMS

1. A method for manufacturing a resistor function in an electric conductor on the surface of a carrier, preferably a conductor on printed circuit boards, substrates and chips, c h a r a c t e r i s e d in that the conductor, by etching using an anisotropic etching technique, is provided with at least one portion which has a smaller cross-sectional area than the conductor surrounding the portion, the length and width of the portion being such that a predetermined resistance is obtained in the conductor.

2. A method as claimed in claim 1, c h a r a c - t e r i s e d in that the conductor is provided with a plurality of parallel portions whose total cross-sectional area is smaller than the cross-sectional area of the surrounding conductor.

3. A method as claimed in claim 1, c h a r a c - t e r i s e d in that a portion of the conductor is etched by using an anisotropic etching technique so that said portion obtains a greater length and a smaller width than the original portion.

4. A method as claimed in claim 1, c h a r a c - t e r i s e d in that the reduced cross-sectional area consists of a reduction of the width of the conductor in the plane of the surface.

5. A method as claimed in any one of claims 1, 2, 3 or 4, c h a r a c t e r i s e d in that the anisotropic etching is a wet etching method, and that it further comprises the step of

performing anisotropic etching by arranging an electric field in the etching fluid adjacent to the conductor, the etching fluid being present in such a diluted solution that it is not capable of etching the conductor without an electric field, but in concentrated form etches the conductor without an electric field.

6. A method as claimed in any one of the preceding claims, c h a r a c t e r i s e d by the steps of

measuring the resistance of the conductor during etching, and

interrupting the etching when the measured resistance corresponds to the predetermined resistance.

7. A method as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the conductor is coated with a further layer.

8. A resistor which on both sides is connected to a conductor on a carrier, such as a printed circuit board, a substrate or a chip, c h a r a c t e r i s e d in that the resistor comprises a conductor portion which is positioned on the carrier and which has a significantly smaller cross-sectional area than the conductor on both sides of the resistor.

9. A resistor as claimed in claim 8, wherein the conductor portion of the resistor has been given a smaller cross-sectional area by anisotropic etching.

10. A resistor as claimed in claim 8 or 9, c h a r a c t e r i s e d in that the conductor portion with a significantly smaller cross-sectional area consists of a plurality of parallel conductors whose total cross-sectional area is smaller than that of the surrounding conductor.

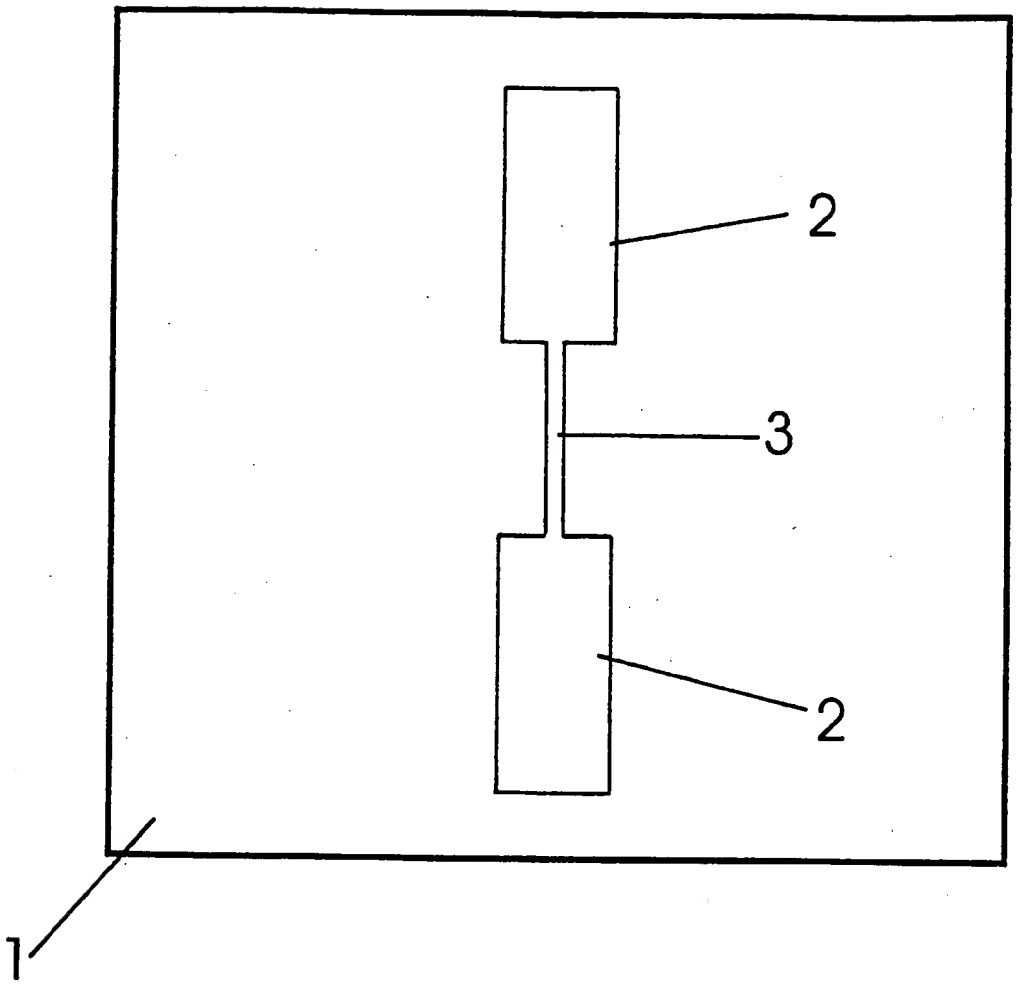
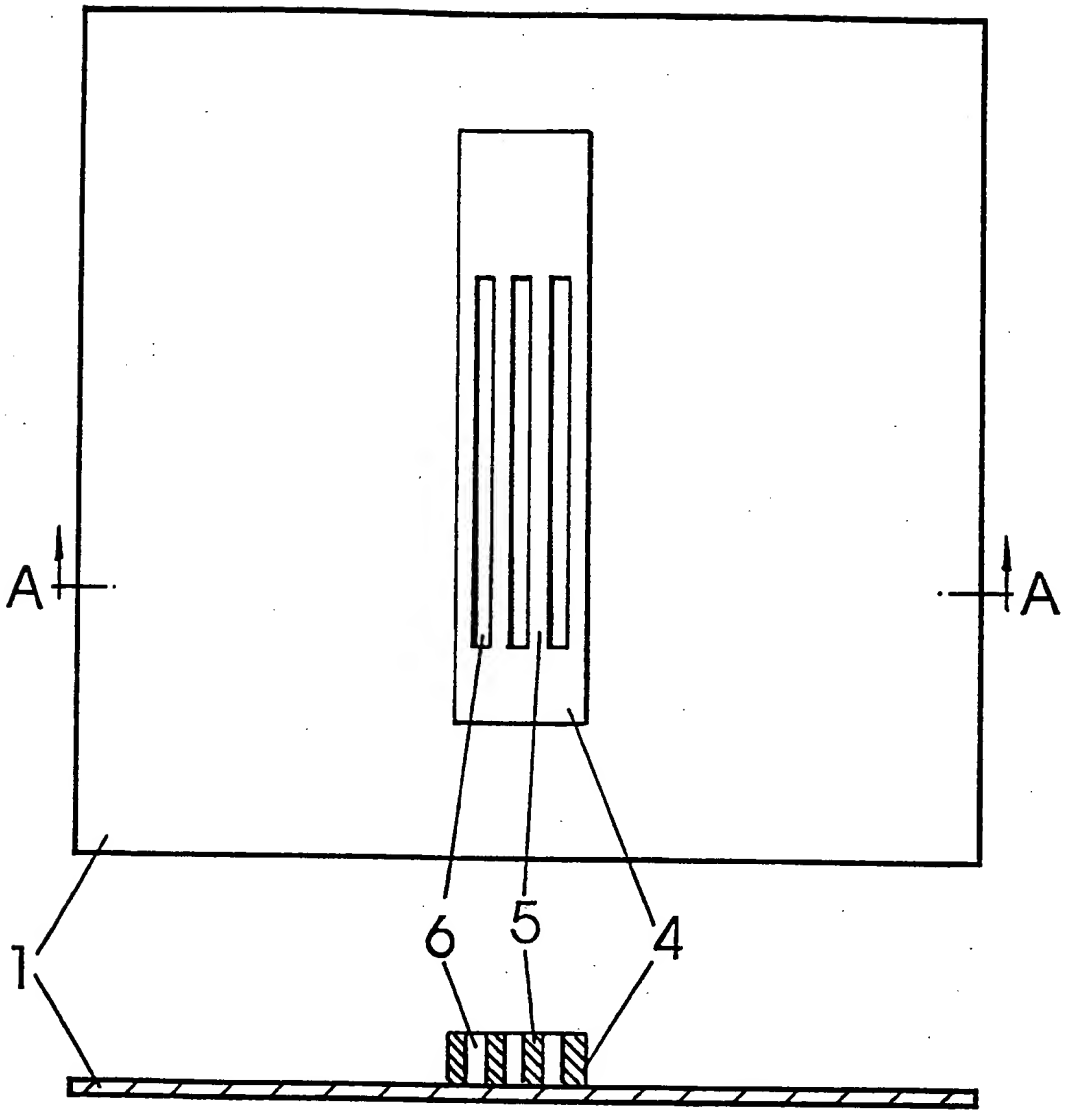


Fig. 1.

Fig. 2.**a**



A-A

Fig. 2.**b**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00325

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H05K 1/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H05K, H01L, H01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0163760 A2 (NIPPON MEKTRON LTD.), 11 December 1985 (11.12.85) --	1-10
A	EP 0719079 A1 (KANTO KASEI CO., LTD.), 26 June 1996 (26.06.96) --	1-10
A	IBM Technical Disclosure Bulletin, Volume 33, No 10A, March 1991; "DECOUPLING CAPACITOR INCORPORATED IN PRINTED CIRCUIT BOARD" --	1-10
P,A	EP 0837623 A1 (MACDERMID INCORPORATED), 22 April 1998 (22.04.98) --	1-10

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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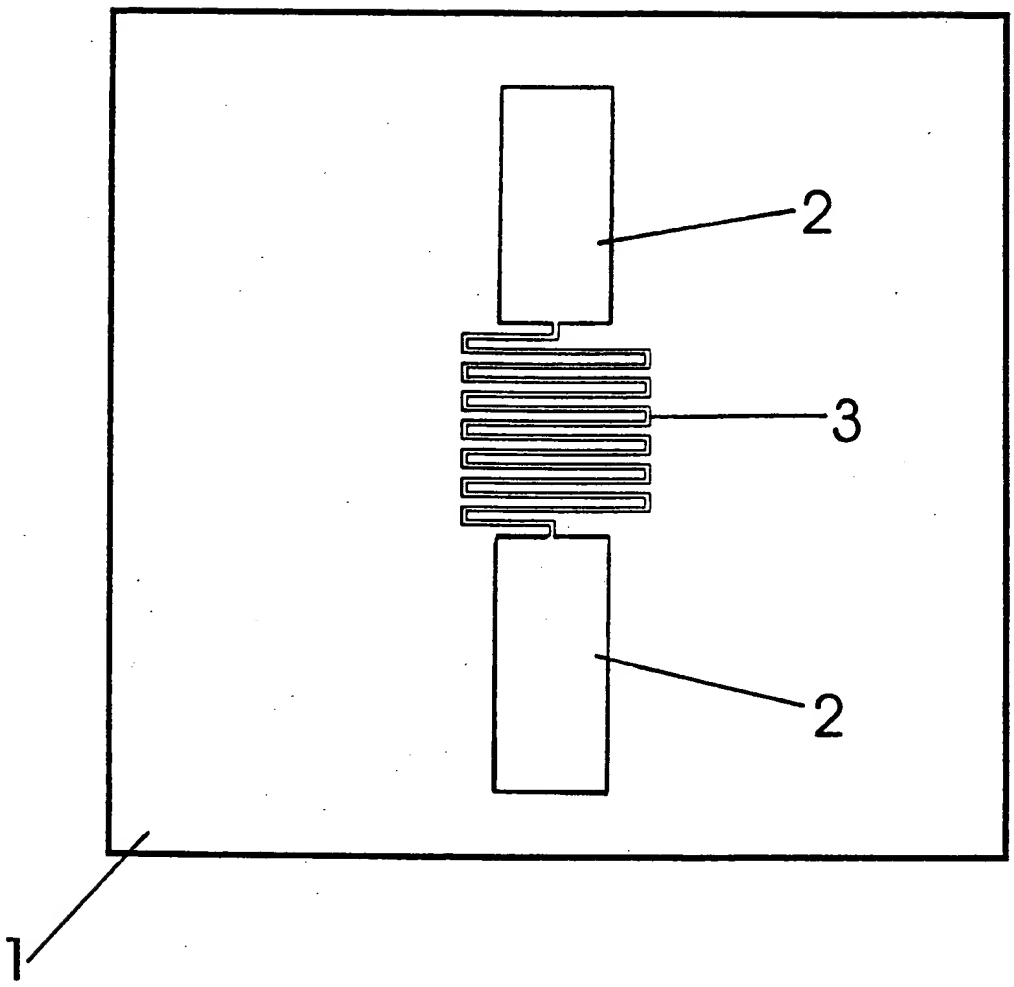

Fig. 3